# Elliptic flow and freeze-out from the parton cascade MPC

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**Abstract**

New solutions of 3+1D covariant kinetic theory are presented for nuclear collisions in the energy domain $E_cm \sim 200A$ GeV. They are obtained using MPC, a new Monte-Carlo parton transport technique that employs very high parton subdivision that is necessary to preserve covariance. The transport results are compared with ideal hydrodynamics solutions. We show that the transport evolution differs significantly from hydrodynamics. In addition, we compare the transport freeze-out distributions to those obtained from ideal hydrodynamics with the Cooper-Frye isotherm freeze-out prescription. The transport freeze-out four-volume is shown to be sensitive to the reaction rates and deviates from both timelike and spacelike freeze-out 3D hypersurfaces commonly assumed. In particular, we find that there does not exist a universal freeze-out temperature. Also, the transverse momentum distributions are found to deviate by up to an order of magnitude from (Cooper-Frye frozen) ideal hydrodynamics for a wide range of possible initial conditions and reaction rates at RHIC energies. The evolution of elliptic flow is followed through the partonic phase and subsequent hadronization. For low transverse momenta, elliptic flow rises linearly with transverse momentum, while it is observed to drop at large transverse momenta. This turn-over behavior is sensitive to the differential cross section. Finally, elliptic flow is sensitive to the applied hadronization scheme, therefore, it can be used to discriminate between such schemes.

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